REMARKS

Claims 1-3, 5-7, and 9 were rejected for anticipation in view of Marko. Claims 4 and 8 were rejected as unpatentable over Marko in view of Carlson. Applicant requests reconsideration.

New claim 10 was added to recite that the baseband waveform signal as claimed has zero crossings from which pulses are generated. New claim 11 was added to recite the baseband waveform signal is modulated using various modulation methods.

Marko's system does not generate transition pulses, and does not generate transition pulses from zero crossings, does not generate transition pulses from zero crossings of baseband signals, and does not generate transition pulses that are synchronized to the baseband waveform signal.

Claim 1 in part reads: "A timing recovery loop for generating adjusted timing pulses from a <u>baseband signal waveform encoding a self clocking digital bit stream</u>, the timing recovery loop comprising,

a pulse detector for generating data transition <u>pulses from the baseband signal waveform</u> . . . . the data transition pulses <u>being synchronized</u> to the baseband waveform, ...

a timing pulse delay adjustor . . . . for <u>delaying the adjusted timing pulses for synchronizing the adjusted timing pulses with the data transition pulses</u> and with the baseband signal . . . .

Yet the examination states "The applicant also indicates the recovered data signal as disclosed in Marko is not a wideband waveform encoding a digital bit stream. Such a limitation is not recited in the claim, thus, such limitation has not been considered." Apparently, claim 1 has also not been fully considered for what it literally claims and suggests that the examination has failed to understand the significance of the technology disclosed, the claims recited, the cooperative interaction of the claimed elements, or the advancement in the art. The examination appears oriented toward arguing that applicant's transition pulses are the same as Marko's transitions. The examination to date has apparently failed to fully comprehend what is the invention. This is remarkable. In order to focus and assist the examination, applicant added claim 10 which directly claims the zero crossings of the baseband waveform signal. However, the examination did not examine as to new claims 10 and 11, and hence, yet another RCE.

Perhaps applicant can be of assistance. In the world of communications, transmitted signals are downconverted from the RF regime to baseband waveform signals through carrier demodulation. The baseband waveform signal typically has transitions through the zero ground voltage level referred to as zero crossings. Zero crossings are well known features. A simple comparator to ground will toggle as the baseband waveform signal crosses zero voltage level. The baseband waveform signal is characterized by a signal moving between positive and negative voltages, for example, a sinusoidal signal, having repeating zero crossings. A characteristic of these baseband waveform signals is that they

normally do not have abrupt transitions, but rather have smooth signaling when moving between positive and negative voltage levels, and through the zero crossings. As such, baseband waveform signals cross zero voltage in each cycle that may be of a bit duration.

A data demodulator can further demodulate the baseband waveform signal into a digital signal characterized as having highs and lows, such as Marko's recovered data signal 406. In common TTL logic circuitry, for example, the high state is about 3.5V and the low state is about 0.2V, when operating on conventional +5V power rails of +5.0Vdc and 0.0Vdc. Due to internal transistor voltages necessary for switching, the output does not switch between 0V and 5V, but rather switches between 0.2 and about 3.5V. The digital bit stream is thus a digital signal, characterized as having two states and transits between these two states in a digital bit stream. This digital signal does not have any zero crossings, a consequence of the baseband waveform being demodulated into a digital signal. The digital signal is also considered, due to its low frequency, to be a baseband signal.

Thus, there is an inherent difference between a baseband digital signal and a baseband waveform signal. A baseband digital signal abruptly transits between the two states e.g. 3.5V and 0.2V. A baseband waveform signal smoothly transits through zero voltage level during a zero crossing from a predetermined maximum voltage at a maximal level to minimum voltage at a minimal level. The baseband waveform signals have repeating zero crossing transitions

whereas baseband digital signals have repeating transitions completely above zero voltage.

The background of the current application made reference to the prior art, of which Marko is one of many examples, where digital systems have long used random walk filters. The present invention also uses a random walk filter. A random walk filter counts MINUS early events and PLUS lag events, and accumulates these events over time. Consecutive early events or consecutive late events indicates that timing is off, and an adjustment is needed, to center the timing between early times and late times.

Marko demodulates the received signal into the recovered data signal 406 using a demodulator. The recovered data has transitions, particularly leading and trailing transitions of a digital bit stream. These transitions are bit boundaries. These transitions can occur at various times, that is, the trailing transition occurs at a multiple of some digital sampling time after the leading transition. Marko teaches that the recovered data boundaries are in 1/32 increments. As such, the transitions are not perfectly aligned in time and timed to the baseband waveform signal, but rather, are closely timed within 1/32 of the bit duration. The recovered data signal and a recovered clock signal are phase detected for generating early and late events that are accumulated. In determining the early and late events, transitions of the recovered clock are compared to transitions of recovered data. That is, two digital streams are phase compared using respective transitions. The recovery clock is used to sample the recovered data signal for

determining the data bit stream. When the accumulation of early or late events occur, the recovery clock is adjusted by a reference clock, so that, the recovery clock is more centered within a bit duration of the recovered data so as to more precisely sample the recovered data in the bit center for precisely generating the data bit stream. The adjustment to the reference clock however is done by dividing by either 31 or 33. That is, the recovery clock is also adjusted by 1/32 duty cycle duration. The 1/32 bit boundaries of the recovered data signal is a major error to precise bit timing. The 1/32 duty cycle duration of the recovered clock is a minor error to precise bit timing.

The present invention does not firstly represent the baseband waveform signal by a digital bit stream, as does Marko. Significantly, the present invention generates transition pulses directly from the baseband waveform signal as the baseband waveform signal crosses zero. The transition pulses are directly aligned in time to the zero crossings of the baseband waveform signal, and as such, the transition pulses are in fact synchronized to the baseband waveform signal. Because the transition pulses are precisely aligned in time to the baseband waveform signal and are thus synchronized to the baseband waveform signal, there is no MAJOR error associated with the use of the transition pulses relative to the baseband waveform. There of course can be slight error due to noise, but using a baseband waveform signal with a high signal-to-noise ratio, that error is negligible, with the transition pulses perfectly aligned in time and synchronized to the baseband waveform signal.

These transition pulses are compared, using a window search, to the adjusted timing pulses for generating early and late events that are accumulated. A reference clock can be used for search in the time window. A reference clock duration or multiple of reference clock durations can be used for the comparison. The use of a conventional reference clock duration for searching the window introduces the MINOR errors associated with using a reference clock for determining early and late events. When the early or late accumulated events exceed a predetermined number, the adjusted timing pulses are adjusted.

The present invention is characterized as generating transition pulses at the very point in time when the baseband waveform signals crosses zero voltage. As noise can be superimposed upon the baseband waveform signals affecting the zero crossings, noise can cause timing problems. When perfectly timed without noise or with high signal-to-noise signal, the transition pulses line up exactly with the zero crossings of the baseband signal thereby eliminating the MAJOR bit boundary timing errors. These transition pulses are then used to generate early and late events to drive the accumulation of events as part of the random walk filter having a count that appears at times to randomly increase and decrease over time.

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In the prior response, applicant asserted that: Marko does not anticipate the present invention, at least, because:

1) Marko uses a recovered data signal as the input that is not the baseband waveform signal encoding a data bit stream, (and this gives rise to Marko having the MAJOR error while the present invention does not);

2) because Marko's early and late increments are based upon phase detection of transitions of the recovered data signal and the recovered clock and not based on pulses generated from the baseband waveform signal, (as there is a clear difference between the generation of early and late events, where Marko compares transitions of the recovered data and recovered clock signals, whereas, the present invention uses a search window between the transition pulses and the adjusted timing pulses); and

3) because the phase error in Marko is determined from transitions of two digital signals, and not from transition pulses (where Marko adjusts the recovery clock having the MINOR errors that is coupled to the MAJOR timing bit boundary errors by phase detection comparison to the recovery data, whereas the present invention adjusts the adjusted timing pulses having the MINOR reference clock errors but without coupling the MINOR errors to any MAJOR errors).

Marko and the present invention are distinguished in a first significant way. Marko demodulates the received signal into the recovered data signal that introduces the bit boundary MAJOR timing error. The present invention completely avoids this bit boundary MAJOR timing error by generating transition pulses aligned in time

to the zero crossings, more generally, as generating synchronized transition pulses that are in fact perfectly aligned in time and hence synchronized to the baseband waveform signal. It is this perfect alignment in time that provides exact synchronization that eliminates the MAJOR bit boundary MAJOR time error.

Marko and the present invention are distinguished in a second significant way. The actual implementation of the random walk filter is completely different. Marko compares transitions of the recovered data and the recovered clock for adjusting the recovered clock, whereas, the present invention uses time aligned synchronized transition pulses and adjusted timing pulses for adjusting the adjusted timing pulses for data detection. In the preferred form, a window search is used for comparing the transition pulses to the adjusted timing pulses for generating the early and late events.

Marko and the present invention are distinguished in a third significant way. Marko couples the MAJOR bit boundary timing errors with the recovered clock adjustment MINOR clock timing errors when comparing the transition of the recovered data and recovered clock. The present invention uses the transition pulses and the adjusted timing pulses without coupling to the MAJOR and MINOR errors as there simply are not MAJOR bit boundary timing errors in the present invention. The preferred window search introduces the MINOR reference clock MINOR timing errors. But, there is no coupling between the bit boundary MAJOR timing errors and the reference clock MINOR timing errors in the present invention.

Claim 1 particularly recites that transition pulses are synchronized to the baseband waveform. Marko has no transition pulses, nor one that is synchronized by time alignment to the zero crossings that are aligned in time to the baseband waveform and used to generate the transition pulses. Marko simply does not have such transition pulses, or such synchronism, or such synchronism extending over several bit periods.

Claim 10 particularly recites the zero crossings, so that there would be no misunderstandings between which type baseband signal is being claimed, that is, a baseband waveform signal specifically characterized by repeating zero crossings, and Marko's recovered data signal having bit boundary MAJOR timing errors.

The repeating zero crossings of the baseband waveform signals and the repeating digital transitions of the recovered data signal are both used for self-clocking for determining an accurate clock in coherent relation to a local oscillator. The high and low states of the digital bit stream and the baseband waveform signals provide informational content for demodulating the signals into data. Both Marko and the present invention use a random walk filter. However, the present invention departs from Marko by using transition pulses timed aligned to the baseband waveform so as to eliminate the MAJOR bit boundary timing errors.

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The present invention is fundamentally different than Marko in the manner that affects performance. The present invention generates transition pulses from zero crossings of a baseband waveform signal. With sufficient signal-to-noise ratio, the pulses are exactly positioned at the zero crossings for precise timed aligned and hence synchronization for improved data detection. Marko first demodulates the received signal into the recovered data signal that is a digital bit signal having bit boundaries position in discrete steps representing an inherent MAJOR bit boundary timing error of 1/32 bit duration. By using time-aligned synchronized transition pulses, the present invention does not suffer from bit boundary MAJOR timing errors. Both Marko and the present invention suffer from the reference clock MINOR timing errors.

In summary, the present invention is fundamentally different than Marko in a manner that directly affects performance. There are two major contributions to timing errors. A first and dominant contribution is the creation of transitions relative to the baseband signal by bit boundaries. The second and minor contribution is the increment in the data detection timing where adjustment is made to the recovered clock in Marko or the adjusted timing pulses of the present invention.

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The present invention generates transition pulses at zero crossings from a baseband waveform signal. The zero crossing transitions are compared to the adjusted timing pulses to further adjust the adjusted timing pulses. As such, the first and dominant contribution to timing error is effectively zero with high signal-to-noise ratio for accurate zero crossing detection. The timing recovery loop is limited by the accuracy of the position of the adjusted pulses to the actual zero crossings of the signal waveforms. A high speed reference clock is used to adjust the adjusted timing pulses in very small increments as a minor limitation of accuracy. Thus, the present invention has no limitation on the dominant MAJOR bit boundary errors, but retains, like Marko, the MINOR reference clock timing error associated with fine increments of the adjusted pulses from using any high speed reference clock. As such, the present invention eliminates the dominant MAJOR bit boundary timing error by using time-aligned synchronized transition pulses and only retains the minor error associated with increments of adjustment of the adjusted timing pulses from a reference clock.

Marko first digitizes the baseband waveform into a digital bit stream having the 1/32 bit boundary MAJOR timing error inherent as the dominant error. Next, Marko uses a high speed reference clock 2.304 MHz (32 times 72 kHz) clock that is then divided by 31 or 33 so as to introduce a MINOR reference clock timing error, at 1/32 of the MAJOR timing error, associated with incremental adjustment of the recovery clock. As such, Marko has coupled the major bit boundary timing error and the minor reference clock timing error

associated with conventional digital tracking loops using random walk filters. As the signal-to-noise ratio of an incoming signal increases, the present invention transition pulses are exactly time aligned eliminating any offset, but Marko will still retain the MAJOR bit boundary timing error, as a severe limitation.

Marko does not anticipate the present invention because 1) Marko uses a recovered data signal as the input and not the baseband waveform encoding a data bit stream; 2) because Marko's early and late increments are based upon transitions of the recovered data signal and not based on precise transition pulses generated from the baseband waveform; and 3) because the phase error in Marko is determined from transitions of a digital bit stream, and not from transition pulses of zero crossings from baseband waveform, resulting in phase error that is a coupling of the bit boundary timing errors with reference clock timing errors.

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Marko does not suggest the present invention, at least, because: 1) Marko teaches away from the present invention by firstly demodulating the received signals into a recovered data signals in advance of data detection introducing bit boundary timing errors, which is completely contrary to applicant's data detection directly upon zero crossings of the baseband waveform, 2) because Marko's demodulation of the received signals into the recovered data signals injects jitter errors due to discrete 1/32 bit boundaries quantization, that is counter-intuitive to the use of zero crossings of baseband waveform signals. Applicant requests allowance of claims.

Respectfully Submitted

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